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A NEW SPECIES OF *CICINDELA* FROM IDAHO (COLEOPTERA: CICINDELIDAE)

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There has been a steady decrease in the discovery rate of new *Cicindela* species in the United States of America; especially during this century. This should be expected because of the intensive investigations of the genus that began during the last century and that have continued to this time. The later discoveries were made in the western part of the country, mostly in the region that lies between the Rocky Mountains to the east, and the Sierra Nevada and Cascade ranges to the west; centered almost exclusively within the Basin and Range Province. There are numerous sand dunes in this region, many of which are still remote and not readily accessible. As more of these dunes are investigated, they may yield a few additional species. The last species to be described was *C. theatina* by Rotger in 1944, a species endemic to the San Luis Valley sand dunes located in southcentral Colorado. The new species described here is from the sand dunes of the Snake River Valley in southern Idaho. In morphology, habitat, and ecology it is more closely related to *C. theatina* than to any other species.

Acknowledgments

The author is indebted to Dr. William F. Barr of the University of Idaho for specimens and locations of this new species. The first discovery was made in June, 1963 when Dr. Barr led a number of graduate students on a field trip to the St. Anthony Sand Dunes in southeastern Idaho. This was followed by another field trip in June, 1964. Collectors were Dr. W. F. Barr, O. O. Fillmore, R. L. Wescott, and G. B. Hewitt. Mr. Donald S. Horning, a research associate of the University of California–Davis visited this site in July, 1966 and submitted two specimens to the author for identification.

Systematics

Cicindela arenicola Rumpp, new species.

Medium size, narrow, convex; head and thorax bronze, elytra bronze with extensive white maculation covering the greater portion of the elytra. *Head:* Bronze on vertex, in wrinkles next to eyes, and on front, other areas green to deep blue; vertex and front covered with fine wrinkles, frons punctured, each puncture bearing a decumbent hair; hairs also between eyes; clypeus bright green turning to blue at outer edge, a few white hairs at outer edge; labrum feebly unidentate, one-third wider than long, white, slightly darker on outer edge, eight or more hairs near forward edge; first four segments of antennæ bronze, first segment with a few setigerous punctures bearing white hairs a third of the way from the base, and three more near the tip, third segment slightly longer than the fourth by a ratio of 11 to 9. *Thorax:* Pronotum subquadrate, a fourth broader than long, with a slight longitudinal blue impression, and deep transverse blue impressions; disk bronze with slight wrinkles, smooth above anterior impression, wrinkled and bronze below posterior impression; long white hairs over one-third edge of pronotum, hairs along upper edge nearly to the middle. *Elytra:* Pigmented area dull bronze, micro-reticulated with extremely fine green impressions, the impressions with raised forward edge on disk only; elytra long and narrow, broadest just below half, curving to apex along a slightly tapered line; outer edge micro-serrulate with a small spine at apex; narrow epipleura bronze; maculation broadly confluent, humeral lunule blending smoothly into the middle band, the extension of the middle band is long and meets the broad apical lunule at the suture, this band also meets the apical lunule along the outer edge, so that a small bar of pigment is formed in a large area of white in the upper third of each elytron; a few pigmented setigerous punctures can be seen in the humeral fold and near the apex, these last are extensions of a row of green punctures near the suture. *Underside:* Greenish blue, metallic; genæ with longitudinal ridges bearing long white hairs below the eyes; proepisterna with dense long white hairs; the mesepisterna, metaepisterna, and coxæ clothed with dense long white recumbent hairs as well as a row of these hairs at upper edge of each sternite; femora green, tibæ and tarsi greenish bronze; long white bristles on femora, more numerous on tibiæ, and also extremely long on tarsi where both the middle and terminal setæ are as long or longer than half the tarsal segment; rear tarsal claws slightly longer than terminal segment, gently curving inward; penial notch semicircular and on left side of body, the cleft starting at the median line of the body.

The female is similar to the male, except she is longer and the elytra are broader; however proportions are nearly similar. *Dimensions:* Male—length 12.3 mm., width 4.7 mm. Female—length 12.9 mm., width 5.1 mm.

The name is derived from the Latin *arena* a sandy place, and *colo* to dwell in, hence dweller in a sandy place.

HABITAT

As its name implies, *C. arenicola* is a sand dune dweller. It is found in the Snake River Valley of southern Idaho, on sand dunes located several kilometers from the river. The specific locations are at the St. Anthony Sand Dunes and the dunes at Sand Dune Lake. At both locations, the dunes are composed of fine buff-colored sand, nearly similar in color and texture to the Great Sand Dunes in the San Luis Valley, Colorado, but not nearly so fine nor so red as the Coral Pink Sand Dunes of southwestern Utah. These dunes are of the wet type, at least in those places where the populations are found.

The topotypical location in the St. Anthony Sand Dunes is approximately 11 km. northeast of St. Anthony, Fremont County, Idaho, in the upper Snake River Valley, not over 50 km. from Yellowstone National Park, at an elevation of 1,525 m. (5,000 ft.). The dunes trend southwest to northeast, somewhat parallel to the valley, and in the direction of the prevailing southwesterly winds.

The Sand Dune Lake location is in southwestern Idaho, a few kilometers northeast of Bruneau, Owyhee County, at an elevation of about 760 m. (2,500 ft.). The lake among the dunes was caused recently by rising ground water. This was the result of water backing into the Bruneau River after the construction of the C. J. Strike Dam.

Since *C. arenicola* has been located at two widely separated places in the dunes of the Snake River Valley it is expected that the species will eventually be found in the intervening regions in similar situations.

INITIAL DISTRIBUTION OF THE TYPE SERIES

Holotype male, in the collection of the California Academy of Sciences, type no. 9374, on permanent loan deposit from the University of Idaho. Allotype, 23 paratopotypes, and 1 paratype in the author's collection. Forty paratopotypes in the collection of the University of Idaho in care of Dr. W. F. Barr; 2 paratopotypes each in the collections of the U. S. National Museum, Washington, D. C. (Dr. O. A. Cartwright); the American Museum of Natural History, New York City (Dr. J. G. Rozen); the California Academy of Sciences, San Francisco, California (Mr. H. B. Leech); the State University of Arizona, Tempe, Arizona (Dr. M. A. Cazier); the University of California–Davis (Mr. D. S. Horning); and the private collection of the Rev. Bernard Rotger, C.R. of Pagosa Springs, Colorado.

THE TYPE SERIES

The variation spread among the 78 specimens of the type series is great enough that a description of the series is warranted. The description of the male holotype is a requirement to type the species and only represents an average, or near average specimen.

NUMBER OF SPECIMENS AND LOCATIONS. Three samples were collected at the

St. Anthony Sand Dunes; sample A on 13 June 1963 consisting of 23 specimens, sample B on 24 June 1964 of 51 specimens, and sample C on 5 July 1966 of 2 specimens. Another one from this location was derived from a larva, emerging as an adult at China Lake, California. One female was collected by T. R. Coupe at Sand Dune Lake on 9 April 1963.

Distribution of sexes. Sample A contained 11 males and 12 females, sample B 30 males and 21 females, and sample C 1 male and 1 female.

Maculation. The typical maculation of both male and female is illustrated in figure 1. However, nearly 20 percent of the specimens have an indentation in the maculation that hints at the shape of a humeral lunule and middle band. Of these, approximately one-fourth, or 5 percent of the total sample, have clearly defined lunules and middle bands. In appearance, these latter approach *C. theatina*; the main differences are in the more descending humeral lunule and the deeper middle band. In all cases where the markings are defined, they are as broad or broader than in *C. theatina*. Neither sex exceeds the other in degree of variation in the maculation.

Color. The St. Anthony samples contain individuals that are mostly bronze in color, with only 4 percent having some indication of a strong greenish tinge. The typical bronze color is reddish with only faint tinges of green. An atypical green color is exceptional, yet the single specimen from Sand Dune Lake is green. It can be matched to a similar specimen from St. Anthony. The adult that emerged at China Lake from a larva collected at St. Anthony is blue-green; however, since it was reared under artificial conditions of moisture and temperature, it is necessary to invalidate this color as normal to the parent population.

Size distribution. Measurements of length, with one replication, made on 10 males and 14 females randomly selected from the topotypical population yielded 12.09 mm. for the average length of the male with a standard deviation of .33 mm., and 12.45 mm. for the average length of the female with a standard deviation of .41 mm. On the average, the male is shorter but less variable in length than the female.

Biology

The phenotype undergoes a continuous change in the adult form. Dwelling in sand dunes exposes it to nearly constant saltation of minute to comparatively large grains of sand, the size depending on wind velocity. It was pointed out in an earlier paper by Rumpp (1961, p. 184) that similar conditions prevail for other species of this group. This constant sandblasting erodes the heavy pile that adorns the young adult until the pile nearly disappears. Running on the fine surface sand eventually erodes the long tarsal claws to half size in the older adult. Color changes occur with age; the pigment darkens, loses its lustre, while the maculation bleaches to a purer white. Integuments also become harder

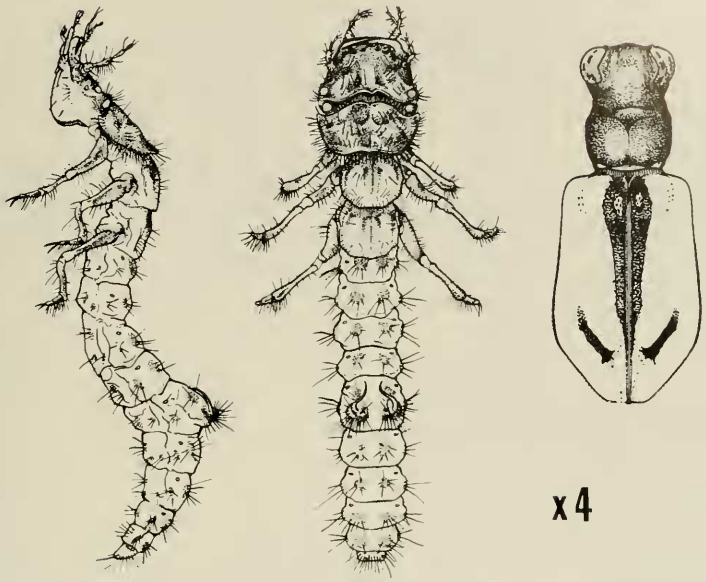

FIGURE 1. *Cicindela arenicola*—larva; side and dorsal view; adult: dorsal view.

with age. The teneral adult is soft and its elytra have a greasy appearance. The holotype falls in the age bracket of young to middle aged.

THE LARVA. The third or last stage instar is slightly over 18 mm. in length, and is illustrated in figure 1. The upper surfaces of the head and first thoracic segment are metallic green with bronze reflections, a brilliance that is typical of the species in the "*limbata*" stem to which this belongs. These bright metallic portions of the larval body are the only ones exposed when the larva is at the top of its hole. The eggs are laid where there is a cover of sparse vegetation. Such locations may be found in the sheltered troughs of the dunes, where permanent moisture is assured. The larva emerges in the moist sand and digs a nearly vertical hole. Holes of the full grown larva were traced in this damp sand for a distance of about 15 cm. to what appeared to be their total depth.

Two larvæ in their final instar were collected at the St. Anthony Sand Dunes on 21 April 1965. It had rained in the early morning of that day, and it remained cloudy until noon. The temperature rose from 9° C. to 14° C. and a strong wind prevailed from the southwest during the morning period. These two larvæ were in the process of clearing their holes by casting out grains of sand, which they brought to the surface on the top of their heads then expelled them by a rapid upward toss of the head. Sand granules extended to about 4 cm. beyond the mouth of each hole. This cleaning-out process was made necessary by the earlier rains that had plugged the top of the holes. One of the

larvæ was preserved in 70 percent ethanol for further study. The other was put into a vial partly filled with sand gathered from the immediate vicinity of its hole. It was subsequently not fed or otherwise disturbed until it emerged as an adult female on 21 June 1965 at China Lake, California, 61 days after capture.

Three larval instars have been observed for *C. limbata albissima*. In all three, the head and first thoracic segment are metallic. Since this species is so closely related to *C. arenicola*, it is probable that this situation will also exist.

Life cycle. The full life cycle is not yet known because of insufficient opportunity for field study, however it must be comparable to the life cycle of other species in the "*repanda*" group. In this group, the adults are double brooded. A portion of the population appear in September to October, then hibernate to emerge again at some convenient time during early spring in the next year; the exact time of this second emergence depends on weather conditions. The balance of the population pass the winter in the larval form, from which the adults eventually appear in late spring. The same generation, therefore, will have fall adults that emerge earlier in the spring than the adults that emerge for the first time only. This continuum of variously aged adults assures greater survivability of the species. This all compares favorably with the larval cycle of *C. hirticollis* as described by Shelford (1908, p. 167). This is mentioned here because *C. hirticollis* belongs to the same group, but to a slightly divergent stem. *Cicindela limbata albissima* belongs to the same stem, hence its life cycle should be more pertinent. Since this has been determined and found to be similar to *C. hirticollis*, it is reasonable to predict that the life cycle of *C. arenicola* will be the same as for the other two species.

It was observed that in *C. limbata albissima* of the Coral Pink Sand Dunes of southwestern Utah, the September to October adults do not develop sexually during the whole period of their fall appearance. Examinations of these adults revealed that the male genitalia were always soft and under-developed so that the penis was incapable of intromittence. These adults are never seen mating, nor even attempting the act during that period. A similar behavior for *C. hirticollis* was described by Shelford (1908, p. 167). His explanation was supported by the fact that he could not find eggs in the females.

Notes on the Male Genitalia

The genitalia of the male of *C. arenicola* are illustrated in figure 2. The ædeagus, penis, or intromittent organ is shown in two views. The dorsal side is defined as that side viewed from the dorsal side of the insect, when this organ is retracted within the body. The other view is of the inner side, defined as that side within the curve of the organ. The penis is bent, creating a salient bulge on the ventral side, which compensates for the asymmetrical penial notch, a condition of the morphology that is unique to the Nearctic "*repanda*" group (= the Palearctic "*maritima*" group of Rivalier (1954, p. 252) and followed

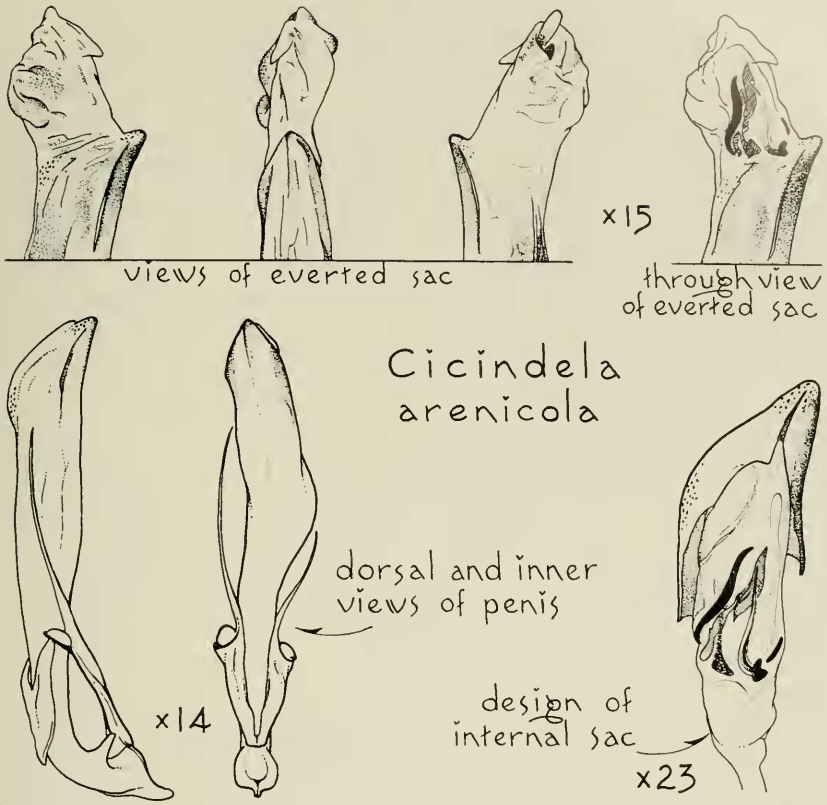

FIGURE 2. *Cicindela arenicola*. Details of the male genitalia.

by Freitag (1965, pp. 1–87)). The parameres are asymmetrical also, the dorsal one being much longer than the ventral one. The whole structure of the penis is more slender and more bulging than in *C. theatina*, which is illustrated in figure 3 for comparative purposes. Note that the tip is more acuminate, the sac fold on the upper outer side protrudes slightly more, and the hardened folds that give the inner tip a spade shape are closer to the inner surface for *C. arenicola* when compared with *C. theatina*.

INTERNAL SAC. This inner organ of the penis contains features that are quite similar to the same organ in other species of the "*repanda*" group. The short flagellum is curved sharply upward near a thick base; its sustained membrane is extremely narrow and extends the full length on the ventral side. The large stiffening rib is nearly as long as the flagellum and dorsad to it, while the small stiffening rib is straight, short, and on the ventral side. The tooth is essentially reduced to a small indistinct fold. The so-called "fields" within

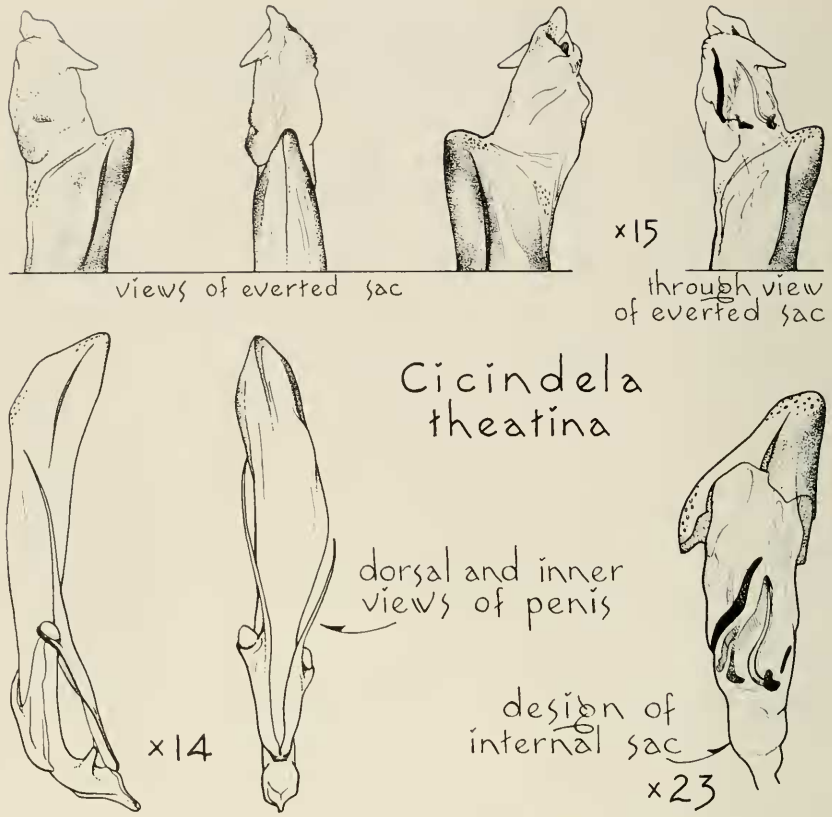

Figure 3. *Cicindela theatina.* Details of the male genitalia.

the internal sac have been mentioned before. Freitag (1965) described the fields from within the sac, at best a most difficult task. In earlier work, Helga Papp (1952) attempted, somewhat unclearly but correctly, to show the fields in relation to the evaginated position of the sac, which is the position of the sac during copulation. The structures within the sac, the fields on the outer surfaces, and the position and shape of the sac in the everted position are all important features pertinent to the study of the male genitalia. Figure 2 illustrates various views of the everted sac as well as the position of the internal sclerites during eversion. The following points are significant:

1. The angle of the everted sac in relation to the approximate centerline of the penis is about 25 degrees. This angular dimension is typical for all species of the subgenus *Cicindela*. For this and other reasons that will be brought out in the future, the genera *Cicindela* and *Cincindelidia* of Rivalier (1954) are reduced to the *Cicindela* subgenus rank.

2. There is a pointed fold or extension of the sac on the exterior, pointed in the dorsal-inner direction in all species of the "*repanda*" group. This is especially pointed in the "*limbata*" stem species, particularly so in *C. arenicola*.

3. There are three fields on the surface of the everted sac consisting of rough spicules; two on the dorsal side, one on the upper ventral side.

4. Comparative analysis: In *C. arenicola*, the pointed fold is more salient than in *C. theatina*; also the lower dorsal field is not situated so low. The everted sac folds out on its upper side near the tip of the penis, whereas in *C. theatina* it is much further back, a distance nearly twice as great. In this respect, *C. theatina* is similar to *C. columbica*, while *C. arenicola* is similar to *C. bellissima*. In *C. columbica* and *C. bellissima*, the fold that bears the lower dorsal field bulges more than in the other two species.

Other Species of *Cicindela* Living in Conjunction with *C. arenicola*

At the St. Anthony Sand Dunes, the water level does not reach the surface, hence only supports those species of *Cicindela* capable of existence on low levels of permanent ground water. *Cicindela tranquebarica* is found in the area near the dunes, intermixed to a degree with *C. arenicola*.

At Sand Dune Lake, the damp sandy shores of the enclosed lake support *C. oregona* and *C. hæmorrhagica* in large numbers, but *C. arenicola* is allopatric to these as it is strictly confined to the dunes.

Relationship with Other Similar Species

The two species *C. arenicola* and *C. theatina* exhibit similarities in ecology as well as in general physiology. They either derived from the same ancestral type or one from the other; the former being the more plausible because of long isolation, which possibly began in late Miocene, but not later than mid-Pliocene. With similar ecologies, their tendency to vary from each other was not overly stressed as long as wet dunes were available. Variations caused by elevation, latitude, and geographic dislocation had effects on average rainfall, temperature, and food availability, causing slightly different effects on these two species. These variables may be the main divergent factors leading to the postulation that speciation, in this instance, resulted from long isolation under minor ecological pressures.

Less physically isolated from *C. arenicola* is the related species *C. columbica* that inhabits the shores of the Columbia, lower Snake, and Salmon rivers (Hatch, 1953, p. 39; and personal collecting along the Salmon River in 1962). However, *C. arenicola* is isolated ecologically from *C. columbica*, and this is as formidable a barrier as any physical discontinuity. *Cicindela columbica* is a riparian sand dweller, sharing the living space along the river bars and beaches with other members of the "*repanda*" group such as *C. oregona, C. repanda,* and *C. hirticollis*; yet each species finds its own micro-ecological niche in these situations. *Cicindela columbica* is most closely related physiologically and ecologically to *C. bellissima* of the Oregon Coast beaches and dunes.

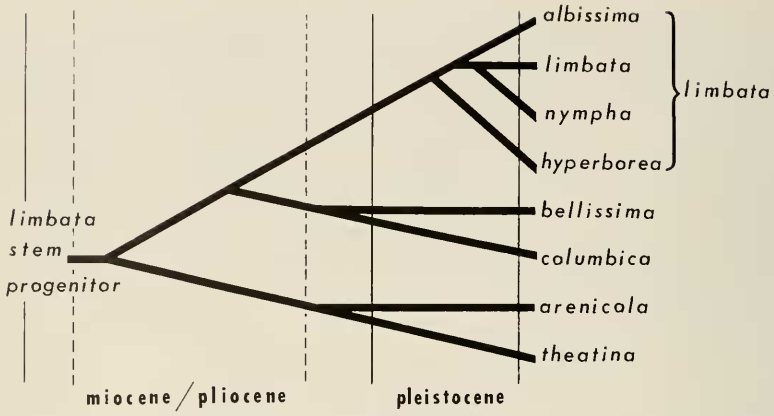

Figure 4. A chronological relationship of the five species of *Cicindela* making up the "*limbata*" stem of the "*repanda*" group in the subgenus *Cicindela*.

A chronological relationship of the five species, which now make up the "*limbata*" stem of the "*repanda*" group, is shown graphically in figure 4. This is strictly a speculative reconstruction since there is no fossil evidence to substantiate it. This representation is only slightly different from Freitag's hypothetical proposal (1965, p. 161).

Additions to the *Cicindela* Fauna of Idaho

1. *C. arenicola* Rumpp	St. Anthony Sand Dunes (Fremont County) and Sand Dune Lake (Owyhee County).
2. *C. columbica* Hatch	Salmon River from Whitebird to Lucile (Idaho County).
3. *C. willistoni echo* Casey	Bruneau River salt flats, Bruneau (Owyhee County).

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